# PATENT COOPERATION TREATY

# PCT



# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| Applicant's or agent's file reference<br>FIN 572 PCT | **FOR FURTHER ACTION** | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| International application No.<br>PCT/IB2004/000272 | International filing date *(day/month/year)*<br>03.02.2004 | Priority date *(day/month/year)*<br>03.02.2004 |
| International Patent Classification (IPC) or both national classification and IPC<br>INV. H01L21/48 | | |
| Applicant<br>INFINEON TECHNOLOGIES AG et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 10.06.2005 | 25.04.2006 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized Officer<br>Cousins, D<br>Telephone No. +49 89 2399-2759 |

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB2004/000272

## I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

**Description, Pages**

1-15, 19 as originally filed

**Claims, Numbers**

1-18 received on 03.12.2005 with letter of 02.12.2005

**Drawings, Sheets**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application,

   ☒ claims Nos. 11-18

   because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

   ☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☒ no international search report has been established for the said claims Nos. 11-18

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the Standard.

   ☐ the computer readable form has not been furnished or does not comply with the Standard.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 8-10 |
| | No: | Claims | 1-7 |
| Inventive step (IS) | Yes: | Claims | 9,10 |
| | No: | Claims | 8 |
| Industrial applicability (IA) | Yes: | Claims | 1-10 |
| | No: | Claims | |

2. Citations and explanations

   **see separate sheet**

## VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

Section V

1. Reference is made to the following documents:
   D1: US-A6114761
   D2: US-A-6239486
   D3: US-A-6259154
   D4: EP-A-1172851

2. From D1 (see column 5, line 39 - column 7, line 2; Figures 2A, 5) a semiconductor package is known comprising:
   a package substrate of the redistribution type having a flip-chip (18) mounted thereon;
   a heatspreading means (50) comprising a planar area and at least one protrusion (54), the planar area being attached to the upper surface of the chip (18) and the protrusion being attached to the upper surface of the package substrate (16).

   From the above-mentioned prior art it follows that the subject-matter of claims 1-7 is known from D1 (Article 33(2) PCT).

3. The additional feature of claim 8 is obvious from the prior art provided by D1 (Article 33(3) PCT).

4. The subject-matter of claim 9 essentially differs from that known from D1 in that:
   - a module-type heatspreading means is provided;
   - sawing grooves are provided in the above;
   - after attaching the heatspreading means to a substrate cpg a matrix of package sites having chips thereon, the individual semiconductor packages are singulated by using the sawing grooves.

   The subject-matter of claim 9 is therefore new (Article 33(2) PCT).

   The problem to be solved by the present invention may be regarded as providing a more economical and efficient production md.

   The solution to this problem proposed in claim 9 of the present application is

considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
D1 gives no hint to the skilled person to use batch manufacture.
D2 describes (see complete document) a cap for a flip-chip, the cap having side wall extending downward, openings being provided in the corners to permit air flow. There is no suggestion to use a batch manufacturing method in the sense of the present application.
D3 (see Figure 5 and accompanying description) describes a semiconductor device including a chip, TAB tape, stiffener, heat dissipation plate, whereby the latter may be provided in lead frame form. There is no disclosure of cutting at the final stage, nor would the skilled person obtain a hint from this document to do so.
D4 (see Figure 2D, Abstract) describes a batch manufacturing method using a heatspreader formed from a metal paste. The latter has no protruding portions and no grooves are provided therein. The skilled person would not be motivated to combine this teaching with that of D1.

5. For completeness it is pointed out that the subject-matter of claims 1,2,5 is known from D2 (Article 33(2) PCT).

Section VIII

In claim 10 it is not clear whether the redistribution board is the same entity as the package substrate referred to in claim 9, both having the reference numeral "4".

Claims

1. A semiconductor package (1) comprising:
   - a semiconductor chip (2) including an active surface with a plurality of chip contact areas (3),
   - a package substrate (4) including a plurality of first contact areas (6) and a plurality of second contact areas (8) on its bottom surface, the chip (2) being mounted on the package substrate (4) with its active surface facing the package substrate (4),
   - a plurality of conducting means (5) providing electrical contact between the chip contact areas (3) and the first contact areas (6), and
   - a heat spreading means (10) comprising a planar area (11) and at least one protrusion (12), the planar area (11) being attached to the upper surface of the chip (2) and the protrusion (12) being attached to the upper surface of the package substrate (4).

2. A semiconductor package according to claim 1 characterized in that
two protrusions (12) are provided, being located on opposite sides of the chip (2).

3. A semiconductor package according to claim 1 or claim 2 characterized in that
the protrusions (12) are provided along the whole length of two opposing sides of the package substrate (4).

4. A semiconductor package according to one of claims 1 to 3 characterized in that
two opposing sides of the package (1) are open.

5. A semiconductor package according to one of claims 1 to 4

characterized in that
open-ended air tunnels (17) extending from one side to the opposing side of the package (1) are formed between the chip (2), the heat spreading means (10) and the package substrate (4).

6. A semiconductor package according to one of claims 1 to 5 characterized in that
the heat spreading means (10) is attached to the chip (2) by thermally conductive adhesive means (15) and to the package substrate (4) by non-conductive adhesive means (16).

7. A semiconductor package according to one of claims 1 to 6 characterized in that
the chip (2) is mounted to a redistribution board (4) using the flip-chip technique.

8. A semiconductor package according to one of claims 1 to 7 characterized in that
the surfaces of the heat spreading means (10, 19) are at least in part black.

9. A method to assemble a semiconductor package (1) comprising the following steps:
- Providing a module heat spreading means (19) comprising:
  - a plurality of sawing grooves (18, 24) on its upper surface, and
  - a plurality of grooves (14) and protrusions (25) in its bottom surface,
- Attaching thermally conductive adhesive means (15) to the grooves (14) and non-conductive adhesive means (16)

to the protrusions (25) of the module heat spreading means (19),

- Providing a substrate (20) comprising a matrix of package sites (21) arranged in an array each including a chip (2) and a package substrate (4),
- Positioning the module heat spreading means (19) on the substrate (20) so that the protrusions (25) are in contact with the package substrates (4) of the substrate (20) and the groove (14) is connected to the upper passive surface of the chip (2),
- Curing the adhesive means,
- attaching a plurality of external contact means (9) to the contact areas (8) on the bottom surface of the package substrates (4) of the substrate (20),
- Singulating the individual semiconductor packages (1) by using the sawing grooves (18, 24) in the upper surface of the module heat spreading means (19) to guide the path of the saw blade.

10. A method to assemble a semiconductor package (1) according to claim 9
characterized in that
the plurality of chips (2) are mounted using the flip-chip technique to a redistribution board (4) at each package site (21).

11. Matrix package comprising:

- a module heat spreading means (19) comprising:
  - a plurality of sawing grooves (18, 24) on its upper surface, and
  - a plurality of grooves (14) and protrusions (25) in its bottom surface,

- thermally conductive adhesive means (15) to the grooves (14) and non-conductive adhesive means (16) to the protrusions (25) of the module heat spreading means (19), and
- a substrate (20) comprising a matrix of package sites (21) arranged in an array each including a chip (2) and a package substrate (4),

wherein the module heat spreading means (19) is positioned on the substrate (20) so that the protrusions (25) are in contact with the package substrates (4) of the substrate (20) and the grooves (14) are connected to the upper passive surface of the chips (2).

12. Matrix package according to claim 11
characterized in that
the plurality of protrusions (25) are positioned approximately centrally between rows of chips (2).

13. Matrix package according to claim 11 or claim 12
characterized in that
the plurality of grooves (14) are positioned approximately parallel to each other.

14. Matrix package according to one of claims 11 to 13
characterized in that
the plurality of sawing grooves (18, 24) are arranged in a square grid array.

15. Matrix package according to one of claims 11 to 14
characterized in that
the package sites (21) are arranged in a square grid array.

16. Matrix package according to claim 14 or claim 15 characterized in that
the sawing grooves (18, 24) are arranged in a square grid array which has approximately the same dimensions and orientation as the square grid array of the package sites (21).

17. Matrix package according to one of claims 11 to 16 characterized in that
the module heat spreading means (19) is attached to the chip (2) by thermally conductive adhesive means (15) and to the package substrate (4) by non-conductive adhesive means (16).

18. Matrix package according to one of claims 11 to 17 characterized in that
the chips (2) are mounted on the package sites (21) using a flip-chip technique.